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ABSTRACT

Two limited studies are reported: (1) a pilot test of sex differences in high school math preparation, and (2) a pilot study of attitudes toward mathematics. The first was a random sample of 81 college applicants (42 boys, 39 girls) which showed that 57 percent of the boys took four years of high school mathematics compared to 8 percent of the girls. The second study summarizes responses on a questionnaire distributed to 38 upper division social science students. Results showed a statistically significant relationship between social support from teachers, parents, and peers and the pursuit of advanced mathematics courses in high school, and between social support and performance. Responses to the survey question of factors influencing student interest and aptitude for mathematics are included. (DT)

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HIGH SCHOOL MATH AS THE CRITICAL FILTER IN THE JOB MARKET

We know that the job market is dismal for untrained people. We know that it is better for people with high school and college degrees. We know that the fields which are opening up in the next ten or fifteen years are based on mathematics training. We know that certain groups of students are less likely to take any more math in high school than is required for admission to the University. These include girls and minority students.

A study of admission applications of Berkeley Freshmen shows that 57% of the boys had taken four years of high school math (first year algebra, geometry, second year algebra, trig and solid geometry.) Only 8% of the girls had done so.

The four year math sequence is required for admission to Math 1A, Chem 1A, and Physics 1A at Berkeley. These courses are required for majoring in every field at the University of California <u>except</u> the "traditionally female" (and hence lower paying) fields of humanities, social sciences, education, and social welfare.

We do not know what causes these large differences in math preparation.

1. Is it sex and ethnic differences in ability?
2. Is it differences in motivation?
3. Is it differences in career aspirations?
4. Is it differences in parental encouragement?
5. Is it differences in peer support?
6. Is it differences in counselor encouragement and advice?

If you have any ideas or suggestions about the causes or possible solutions to the problem of lack of mathematics preparation, please jot them down and send them to: Lucy W. Sells, 1181 Euclid Ave., Berkeley, 94708. 524-0397.

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Pilot Test of Sex Differences in High School Mathematics Preparation

This pilot study was conducted to test the investigator's long standing contention that inadequate preparation in mathematics presents a serious constraint in choice of undergraduate major in college. It was hypothesized that girls applying for admission at Berkeley would be less likely to have taken advanced mathematics than boys.

A systematic random sample of names was drawn from the applicants for admission as Freshmen at Berkeley for the Fall of 1972. The folders were pulled from the files, and coded by sex and number of years of high school mathematics taken by the applicant. Some students take only the minimum entrance requirement of two years, some take three years, and some take four years. The distribution is presented below:

Years of High School Math by Sex: 1972
Berkeley Applicants for Admission as Freshmen

Mathematics	Boys	Girls	Total
Two Years	7%	36%	21%
Three Years	36	56	46
Four Years	57	8	33
Total	100%	100%	100%
(Number)	(42)	(39)	(81)

Source: Berkeley Admissions Office

The difference of forty-nine percentage points between boys and girls among those who took four years of mathematics is striking, and statistically significant at the .001 level. $\chi^2 = 19.942$ with two degrees of freedom.

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Pilot Study of Attitudes Toward Mathematics

This is a summary of an exploratory pilot project on attitudes towards mathematics. A questionnaire was distributed to the members of an upper-division social science class. It contained questions about performance in elementary school, high school; expectations and encouragement by teachers, parents and peers; whether or not respondents had taken mathematics beyond the geometry requirement in high school; and an open ended question on "What do you consider to be the most important factors which influence your interest and aptitude for doing mathematics?"

There were 34 women and 4 men, with no sex differences in the responses.

The first table shows the relationship between encouragement by parents, teachers, or peers, and whether or not students took mathematics beyond the admissions requirements for the University of California.

Advanced High School Mathematics by Social Support

	Some Social Support	No Social Support	Total
Took Advanced Math	13	7	20
Did not take Any Advanced Math	1	17	18
Total	14	24	38

There is a strong ($Q = .94$) and statistically significant ($\chi^2 = 13.87$, $\alpha < .001$ with 1 degree of freedom) relationship between social support from teachers, parents, and peers, and the pursuit of advanced mathematics courses in high school.

The second table shows the relationship between encouragement by parents, teachers, or peers, and performance in the advanced mathematics courses.

	Some Social Support	No Social Support	Total
A's & B's	13	3	16
C's & D's	-	4	4
Total	13	7	20

Again, the relationship between social support and performance in advanced high school mathematics is strong ($Q = 1.00$) and statistically significant ($\chi^2 = 9.29$, $\alpha < .01$ with 1 degree of freedom.)

While it is not possible to generalize beyond the small sample of social science undergraduates, the relationships between social support, taking advanced high school mathematics, and performing well in it are striking. They suggest the need for an experimental project designed to increase the level of social support for those undertaking high school mathematics.

OPEN-ENDED RESPONSES TO "IN SUMMARY, WHAT DO YOU CONSIDER TO BE THE MOST IMPORTANT FACTORS WHICH INFLUENCED YOUR INTEREST AND APTITUDE FOR DOING MATHEMATICS?

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1. FROM THOSE WHO TOOK ADVANCED MATH, AND DID WELL IN IT:

"GOOD GRADES AND ENCOURAGEMENT OF TEACHERS. ALSO I SIMPLY ENJOYED IT. I DO KNOW THAT IF KIDS WERE NOT ESPECIALLY INTERESTED IN TAKING MORE MATH, HIGH SCHOOL COUNSELLORS DID NOT PUSH THEM TO."

"I DID WELL IN MATH IN MY PRE-HIGH SCHOOL YEARS & HAD CONFIDENCE IN MY ABILITY TO HANDLE IT IN HIGH SCHOOL. I WAS ENCOURAGED BY MY TEACHERS IN HIGH SCHOOL BUT WAS NOT ENCOURAGED (IN FACT DISCOURAGED) TO CONSIDER A COLLEGE MAJOR IN MATH."

"SELF-MOTIVATION AND PARENTAL SUPPORT. ALSO COMPETITION BETWEEN ALL OF THE KIDS (OVER 200) IN THE ADVANCED CLASSES IN MY HIGH SCHOOL. WE ALL TOOK THE SAME COURSES. IT NEVER OCCURED TO ME THAT I COULDN'T DO WELL IN MATH - ONLY THAT MORE EFFORT MIGHT BE REQUIRED THAN SAY IN ENGLISH."

"MAINLY, MY ABILITY TO DO WELL IN MATH. ALSO MY COUNSELOR AND MY PARENTS ENCOURAGED ME TO TAKE HIGHER LEVELS OF MATH AS PREPARATION FOR COLLEGE."

"I HAD PLANNED TO DISCONTINUE MATH AFTER THE MINIMUM UNIVERSITY REQUIREMENT OF TWO YEARS, HOWEVER BECAUSE OF A GOOD MATH DEPARTMENT I CONTINUED 'JUST IN CASE' MY INTERESTS HEADED IN THAT DIRECTION - ALSO PEERS DECIDED TO CONTINUE. HOWEVER, BY SENIOR YEAR I WAS ONLY FEMALE IN CLASS."

"I DID WELL IN JR. HIGH, MY PARENTS WERE PLEASED. I TOOK 3 YEARS OF MATH PARTLY BECAUSE I KNEW I DID FAIRLY WELL IN THE FIELD & I WISHED TO HAVE A GOOD BACKGROUND FOR COLLEGE. THERE WAS ENCOURAGEMENT TO TAKE MATH & SCIENCE, AND ALL THE COLLEGE-PREP COURSES."

"I DID WELL IN MATH BECAUSE I HAVE AN ORGANIZED MIND. I HAVE RECEIVED AN 'A' IN ALMOST EVERY MATH CLASS I HAVE TAKEN, INCLUDING COLLEGE LOGIC. BUT MY MAJOR IS ENGLISH, IN WHICH I DID CONSISTENTLY WELL, BUT NOT WITH A STRAIGHT 'A'. THE DICHOTOMY MUST MEAN SOMETHING IN MY SOCIALIZATION WHICH I CANNOT PUT MY FINGER ON."

"I FEEL I HAVE AN INBORN FEEL FOR NUMBERS. I ENJOY CALCULATIONS AND ALTHOUGH MANY MALE CLASSMATES FELT COMPETITION, THIS NEVER BOTHERED ME. I DON'T EVER REMEMBER ANY DISCOURAGEMENT TOWARD MATHEMATICS. I WAS CONSTANTLY ENCOURAGED FROM ALL SIDES. I MUST ADD THAT I WAS ALMOST A MATH MAJOR, BUT DECIDED TO US IT PRACTICALLY INSTEAD." (!)

"MY FATHER AND MALE MATHE TEACHERS WERE MOST ENCOURAGING AND THEN MOST DISCOURAGING AS I DID NOT WANT TO CONTINUE IN A FIELD WHICH SEEMED TO STRESS ABSTRACT THOUGHT WITHOUT CONCERN WITH ITS RELATIONSHIP TO PERSONAL EXPERIENCE. THEY SAW MY INTERESTS IN OTHER FIELDS AS IMPRACTICAL, SILLY, SENTIMENTAL. I RESELLED AND DISCONTINUED MY MATH PROGRAM."

"THE ENTHUSIASM OF THE TEACHER FOR HIS SUBJECT & HIS OR HER ABILITY TO COMCUNICATE IT TO ME AND MY FELLOW STUDENTS. ALSO HELPS TO HAVE FELLOW STUDENTS EXCITED ABOUT THEIR WORK."

2. FROM THOSE WHO TOOK ADVANCED MATH, AND DID POORLY IN IT:

"I FELT LESS INTELLIGENT THAN MALES AND SOME FEMALES IN THE CLASS, BUT THIS GAVE ME INCENTIVE. I STILL FEEL THIS WAY, BUT NO LONGER GET INCENTIVE FROM THIS INFERIOR POSITION. A MATH TEACHER CALLED ME STUPID IN FRONT OF THE CLASS ONCE AND THIS HAD A GREAT NEGATIVE EFFECT ON MY OPINION OF MY INTELLIGENCE."

"My first and half of my second year of High School was in a very large co-ed school. Classes in math were mainly boys. Few girls planned college careers. In Soph year I went to a small convent HS for girls. My teachers were nuns. I did very well that year in my math classes, compared to the previous experience. I then transfered to a co-ed religious school. All classes were segregated EXCEPT for math and science, where the school felt they would not have enough women enrolled to warrent an all-women's class. We had a man teacher, it was predominatly a men's class. That year I failed Algebra III & IV. So did many of the other women in the class."

"General feeling from parents that all the members of the family did well in the humanities, poorly in math. This was not a sexist orientation, but very influential. Have since found out that I have a very strong natural bent for math. I grew up feeling that I was not inclined toward math - feeling that other academic areas were more interesting - that I wouldn't have much use for a lot of math - all this even though I did very well in Arithmetic in early school years. My interest in math consistently declined - feelings from peers and from parent were anti-math - not overtly sexist - nevertheless I never considered getting a degree in a field that was predominantly a male field - probably because of a mostly covert sense of the feminine role - ABSOLUTELY NO ENCOURAGEMENT from teachers, parents, peers or anyone."

"My math teachers in high school were mostly men. I remember them as being very cold, impersonal, apathetic of my existence as anything other than a math student. And in the fifth grade when math didn't simk in right away I became very discouraged. According to the tests I've taken I'm supposed to be getting A's in math."

In first grade my teacher told me I was stupid because I didn't understand arithmetic, but offered me no help with it. I know I hated the teacher from that point on and possibly I also hated math."

3. From those who did not take advanced math in high school:

"My good aptitude for math was not encouraged. It was generally ignored and not stressed. I was pushed into fields of social science. If I had been encouraged to continue in math, I would have continued. But my straight 'A's in math were noticed by no one. My social science 'A's were heartily encouraged."

"My parents and teachers never encouraged and in some cases, discouraged my interest in any profession. (They assumed I would marry and have children.) I never saw any need for math beyond the beginning levels because I did not intend to go into any profession requiring it. I was, at one time in high school actively interested in chemistry and university work in pharmacy, but my chemistry teacher ignored it and did not respond to my stated interests. (I got A's in Chemistry.) and my parents felt my ambitions were foolish,so I gave up my first interest in chemistry, be second interest in business administration. and chose education!"

"None. Everyone discouraged me."

"Everyone told me it was hard and complicated. Although I got good grades in it I didn't really apply myself and very early believed that I didn't understand it and it was over my head."

"I had very poor, apathetic math teachers who never gave technical or psychological help. There was no inspiration to learn and no help when I didn't understand something

"Parochial school 1-8 gave excessive drill and emphasis on efficiency and skill rather than math for fun and creativity."

"My teachers were usually women - then suddenly in 7th and 8th grade there were men teachers and they all taught math or science. Something was going on here and it scared me, so I avoided science and math. The message wasn't verbal, but it was clear. (Influences:) Socialization factors. And fear. It's difficult to step confidently into what is obviously male territory if you're confused about the necessity of taking the course at all, you're unsure about how well you'll do, (if obviously intelligent women refuse math then there must be something magical and terrible about it that only men can handle), you're not even sure you like math. "What a bother," you think, and you take drama."

"Inability to ask questions, fear of looking stupid, considering the unimportance of math in the future for me. Since it was unimportant for me (for various reasons) to pursue math and I had average performance in math most attitudes were neutral but as for myself I was (and am) fearful of math, science (almost mystically) I discourage myself thinking I could not do well."

"My neutrality turned to dislike of mathematics when I began Algebra. Also my interests became focused upon my social life, so the subjects that I felt to be difficult I avoided as much as possible. Math, especially the higher maths, gave me some difficulty. Probably the only high school subject I had to apply much effort at - so I steered away from math and took subjects that afforded me no difficulty."

"I was the top student in my 8th grade class, and even won prices. I thought I would continue in mathematics. Boring, disinterested teachers led to my disenchantment with mathematics, combined with a growing interest in social sciences and humanities. I could have passed any math class offered, but it was my choice, and I chose not to continue in math."

"Poor instruction,uninterested, uninspired by teachers; lack of encouragement from home(except sister tried to help but she could not help enough); my attitude was completely defeatist."

"In the 4th grade I was a slow learner and was placed in remedial math from which I never escaped. There were more boys than girls in my class & we remained together through 12th grade. (Once you get behind in arithmetic, it is difficult for the teacher you get later to catch you up.) I took math every year in Jr. High and High School, & ended up a senior in geometry with 9th graders."

"When in the third grade I missed two weeks of school during which multiplication and division were introduced. Since then I have never regained any confidence in the field. The interest has always been lagging and the aptitude, if any, unfound."

"Too frustrating. Could not see any relevance in working with figures."

"There was a kind of(basically unspoken) pressure from peers, parents, faculty, etc. for males at my school to continue, but a smaller amount of pressure for females. (Females were never discouraged, though, and frequently encouraged.)"